North Carolina (NOC) NERR Meteorological Metadata
January 1st – December 31st, 2017
Latest Update: December 11, 2018

I. Data Set and Research Descriptors

1) Principal investigator(s) and contact persons

Brandon Puckett, Research Coordinator
101 Pivers Island Road
Beaufort, NC. 28516
Phone: 252-838-0851
Fax: 252-838-0890
Email: brandon.puckett@ncdenr.gov

Byron R Toothman, Research Associate
5600 Marvin K. Moss Lane
Wilmington, NC 28409
Phone: (910) 962-2334
Fax: (910) 962-2410
Email: toothmanb@uncw.edu

Heather Wells, Research Associate
5600 Marvin K. Moss Lane
Wilmington, NC 28409
Phone: (910) 962-2335
Fax: (910) 962-2410
Email: wellsh@uncw.edu

2) Entry verification

Data are uploaded from the CR1000 data logger to a Personal Computer (IBM compatible). Files are exported from LoggerNet in a comma-delimited format and uploaded to the CDMO where they undergo automated primary QAQC and become part of the CDMO's online provisional database. During primary QAQC, data are flagged if they are missing or out of sensor range. The edited file is then returned to the Reserve where it is opened in Microsoft Excel and processed using the CDMO's NERRQAQC Excel macro. The macro inserts station codes, creates metadata worksheets for flagged data and summary statistics, and graphs the data for review. It allows the user to apply QAQC flags and codes to the data, append files, and export the resulting data file to the CDMO for tertiary QAQC and assimilation into the CDMO's authoritative online database. For more information on QAQC flags and QAQC codes, see Sections 11 and 12. Byron Toothman and Heather Wells are responsible for station maintenance and data management.

3) Research objectives

The principal objectives are to establish long-term monitoring of the weather in the vicinity of Masonboro Island, to obtain better data on storms and to be able to correlate the weather, water quality, chlorophyll and nutrient data. In addition, the weather data collected will be used in support of other ongoing projects within the Reserve and nearby area.

4) Research methods

Campbell Scientific data telemetry equipment was installed at the NOCRCMET station on 06/15/1997 and transmits data to the NOAA GOES satellite, NESDIS ID #3B02028E. The transmissions are scheduled hourly and contain four (4) data sets reflecting fifteen minute data sampling intervals. Upon receipt by the CDMO, the data undergoes the same automated primary QAQC process detailed in Section 2 above. The "real-time" telemetry data become part of the provisional dataset until undergoing secondary and tertiary QAQC and assimilation in the CDMO's authoritative online database. Provisional and authoritative data are available at http://cdmo.baruch.sc.edu.

Data are collected in Eastern Standard Time (EST) for the entire year.

The 15 minute Data are collected in the following formats for the **CR1000**:

Averages from 5-second data:

Air Temperature (°C), Relative Humidity (%), Barometric Pressure (mb), Wind Speed (m/s), Wind Direction (degrees), Battery Voltage (volts)

Maximum and Minimum Air Temperature (°C) and their times from 5-second data (these data are available from the Reserve)

Maximum Wind Speed (m/s) and time from 5-second data

Wind Direction Standard Deviation (degrees)

Totals:

Precipitation (mm), PAR (millimoles/m^2), and Cumulative Precipitation (mm) (Cumulative precipitation is no longer available via export from the CDMO. Please contact the Reserve or the CDMO for more information or to obtain these data.)

Recommended calibration frequency for the MET station sensors:

- Temperature/Humidity- yearly recalibration
- Rain Gauge- yearly recalibration
- Wind Speed/Direction - yearly or every 2 years (depending on the sensor)
- Barometric Pressure- every 2 years recalibration
- PAR- every 2 years recalibration
- CR1000-every 5 years (required beginning 2014, one year initial grace period)

Data are periodically compared to values recorded by other local weather stations to verify accuracy. Data are also quality checked using Excel. The reports, graphs and queries of meteorological data are reviewed. Anomalous data and errors are further investigated and data are corrected, rejected (if necessary), or left unchanged and noted in the metadata report.

5) Site location and character

The components of North Carolina's National Estuarine Research Reserve (from north to south) are: Currituck Banks, Rachel Carson, Masonboro Island, and Zeke's Island. They are located along the southeast Atlantic coast of the United States. Currently, only data from Masonboro Island and Zeke's Island components are transferred to the CDMO.

The meteorological site is located on Masonboro Island, 2.09 km from the NOC NERR lab, and approximately 76.2 meters from the Research Creek water quality deployment site. The weather station is located on an active dredge spoil island

adjacent to Research Creek east of the Intracoastal Waterway. It is directly across the Intracoastal Waterway from Whiskey Creek, at 34° 9.328'N, 77° 51.054'W. The station sits at an elevation of approximately 4.88 m above sea level, slightly offset from the highest point of the spoil, which has a maximum elevation of approximately 5.8 m. The site has scrub surrounding the periphery, and grassy cover in the central areas. The weather station consists of a 3-meter aluminum tower that holds the wind sensor (wind speed and direction) at a height of 3.68 m and the PAR sensor at a height of 3.66 m. The temperature and relative humidity sensor is mounted on the tower at 2.39 m and the barometric pressure sensor, which is inside of the datalogger housing, is mounted at a height of 1.75 m. The rain gauge is located on a separate platform 7.62 m east south east of the tower and is mounted at a height of 1.79 m. The sensors were wired to the CR1000 (Campbell datalogger) according to the protocol in the Meteorological Monitoring SOP. There are no surrounding objects that obstruct or shade the weather station.

Station Code	Station Name	SWMP Status	Location	Active Dates	Reason Decommissioned	Notes
NOCRCMET	Research Creek	P	34° 9' 19.80 N, 77° 51' 3.24 W	01/01/2001 -	NA	NA

6) Data collection period

Collection of meteorological data began on March 15, 1997. Instruments were deployed prior to this date; however, data were for initial testing and verification of functions, and have since been discarded. The data collection period for 2017 begins on January 1 at 00:00 and ends December 31 at 23:45.

File Start Date and Time	File End Date and Time
12/15/2016 11:00	**1/17/2017 14:15**
1/17/2017 14:30	**2/2/2017 12:45**
2/2/2017 13:00	**3/22/2017 12:45**
3/22/2017 13:00	**4/19/2017 13:45**
4/19/2017 14:00	**5/16/2017 12:30**
5/16/2017 12:45	**7/5/2017 15:00**
7/5/2017 15:15	**9/21/2017 11:00**
9/21/2017 11:15	**10/23/2017 11:45**
10/23/2017 12:00	**11/20/2017 11:45**
11/20/2017 12:00	**1/22/2018 13:45**

7) Distribution

NOAA retains the right to analyze, synthesize and publish summaries of the NERRS System-wide Monitoring Program data. The NERRS retains the right to be fully credited for having collected and process the data. Following academic courtesy standards, the NERR site where the data were collected should be contacted and fully acknowledged in any subsequent publications in which any part of the data are used. The data set enclosed within this package/transmission is only as good as the quality assurance and quality

control procedures outlined by the enclosed metadata reporting statement. The user bears all responsibility for its subsequent use/misuse in any further analyses or comparisons. The Federal government does not assume liability to the Recipient or third persons, nor will the Federal government reimburse or indemnify the Recipient for its liability due to any losses resulting in any way from the use of this data.

Requested citation format:
NOAA National Estuarine Research Reserve System (NERRS). System-wide Monitoring Program. Data accessed from the NOAA NERRS Centralized Data Management Office website: http://www.nerrsdata.org/; *accessed* 12 October 2017.

NERR meteorological data and metadata can be obtained from the Research Coordinator at the individual NERR site (please see Principal Investigators and Contact Persons), from the Data Manager at the Centralized Data Management Office (please see personnel directory under the general information link on the CDMO home page) and online at the CDMO home page www.nerrsdata.org. Data are available in comma delimited format.

8) Associated researchers and projects

Meteorological data will be used to augment other research components of the System Wide Monitoring Program (SWMP) that currently include water quality, chlorophyll and nutrient monitoring. The principal objective of the water quality monitoring is to record long-term water quality data in order to observe and document any physical and chemical changes or trends in water quality over time. The objective of the chlorophyll and nutrient monitoring study is to ascertain the annual and tidal fluctuations in nutrient and chlorophyll a levels surrounding the four water quality sites.

Additional projects are ongoing and continually changing. Check with the Research Coordinator or other contact person for an updated list of research (see section I.1.).

II. Physical Structure Descriptors

9) Sensor specifications

Parameter: Temperature
Units: Celsius
Sensor type: Platinum resistance temperature detector (PRT)
Model #: HMP45C Temperature and Relative Humidity Probe
Operating Temperature: -40°C to +60°C
Range: -40°C to +60°C
Accuracy: ± 0.2 °C @ 20°C
Serial Number: 23568M3
    Date of Calibration: 01/18/16
    Dates of Sensor Use: 02/29/2016 - 04/19/2017
Serial Number: F1640093
    Date of Calibration: 3/7/2017
    Dates of Sensor Use: 04/19/2017 - 11/20/2017

Sensor type: Platinum resistance temperature detector (PRT)
Model #: rotronic HC2-S3
Operating Temperature: -40°C to +60°C
Range: –40 to 60 °C
Accuracy: ± 0.1 °C
Serial Number: 20075980
Date of Calibration: 1/14/2006
Dates of Sensor Use: 11/20/2017- 03/22/2018

Parameter: Relative Humidity
Units: Percent
Sensor type: Vaisala HUMICAP© 180 capacitive relative humidity sensor
Model #: HMP45C Temperature and Relative Humidity Probe
Range: 0-100% non-condensing
Accuracy at 20°C: +/- 2% RH (0-90%) and +/- 3% (90-100%)
Temperature dependence of RH measurement: +/- 0.05% RH/°C
Serial Number: 23568M3
Date of Calibration: 01/18/16
Dates of Sensor Use: 02/29/2016 - 04/19/2017
Serial Number: F1640093
Date of Calibration: 3/7/2017
Dates of Sensor Use: 04/19/2017 - 11/20/2017

Sensor type: ROTRONIC Hygromer® IN1
Model #: rotronic HC2-S3
Range: 0-100%
Accuracy at 23°C: +/- 0.8% RH (0-90%) and +/- 3% (90-100%)
Serial Number: 20075980
Date of Calibration: 1/14/2006
Dates of Sensor Use: 11/20/2017-03/22/2018

Parameter: Barometric Pressure
Units: millibars (mb)
Sensor type: Vaisala Barocap © silicon capacitive pressure sensor
Model #: CS-105
Operating Range: Pressure: 600 to 1060 mb; Temperature: -40°C to +60°C;
Humidity: non-condensing
Accuracy: ± 0.5 mb @ 20°C; +/- 2 mb @ 0°C to 40°C; +/- 4 mb @ -20°C to 45°C; +/- 6 mb @ -40°C to 60°C
Stability: ± 0.1 mb per year
Serial Number: V4730001
Date of Calibration: 05/19/2015
Dates of Sensor Use: 07/22/2015 - 04/19/2017
Serial Number: S2230007
Date of Calibration: 3/29/2017
Dates of Sensor Use: 04/19/2017 - current as of 12/31/2017

Parameter: Wind Speed and Wind direction
Units: meters per second (m/s); degrees
Sensor type: Gill Windsonic Ultrasonic Wind Sensor Option:4
Model #: 1405-PK-100

Range: 0-60m/s; 0 to 359° (no dead band)
Accuracy: ±2% @ 12m/s
Resolution: 0.01m/s (0.02 knots)
Serial Number: 0153215400013 Gill 1405-PK-100
Date of calibration: 09/29/2015, installed new on 02/29/2016
Date of Sensor Use: 02/29/2016 – current as of 12/31/2017

Parameter: Photosynthetically Active Radiation
Units: mmoles m-2 (total flux)
Sensor type: APOGEE Quantum Sensor
Model #: sq-100/200
Light spectrum waveband: 400 to 700 nm
Temperature dependence: 0.06 (±.0.06%) per °C maximum
Stability: <±2% change over 1 yr
Operating Temperature: -40°C to 70°C; Humidity: 0 to 100%
Sensitivity: typically 0.2mV per 1000 μmoles s^{-1} m^{-2}
Multiplier: 0.025 (does not change for this sensor)
Ex. Serial Number: 18787
Date of Calibration: 06/01/2015
Dates of Sensor Use: 02/29/2016 – 04/19/2017
Ex. Serial Number: 18785
Date of Calibration: 06/01/2015
Dates of Sensor Use: 04/19/2017 - current as of 12/31/2017

Parameter: Precipitation (unheated)
Units: millimeters (mm)
Sensor type: Tipping Bucket Rain Gauge
Model #: TE525
Rainfall per tip: 0.01 inch
Operating range: Temperature: 0° to 50°C; Humidity: 0 to 100%
Accuracy: +/- 1.0% up to 1 in./hr; +0, -3% from 1 to 2 in./hr; +0, -5% from 2 to 3 in./hr
Serial Number: 99-36
Date of Calibration: 9/21/2017
Date of Previous Calibration: 11/17/2016
Dates of Sensor Use: 10/03/2009 – current as of 12/31/2017

The CR1000 has 4 MB of Flash EEPROM that is used to store the Operating System. Another 128 K Flash is used to store configuration settings. A minimum of 2 MB SRAM is (4 MB optional upgrade) available for program storage (16K), operating system use, and data storage. Additional storage is available by using a compact flash card in the optional CFM100 Compact Flash Module.
Date CR1000 Installed: 06/28/06 – 02/13/2015**,**s/n:005200
Date CR1000 Calibrated: Factory calibration

Date CR1000 Installed: 02/13/2015 - 7/22/2015 SN#: 33409
Date CR1000 Calibrated: 06/02/2010
CR1000 Firmware Version (s): V19 uploaded at time of delivery 2013

Date CR1000 Installed: 07/22/2015 - current as of 12/31/2017, s/n 005200
Date CR1000 Calibrated: 05/26/2015

CR1000 Firmware Version (s): OS 28(installed during calibration)

CR1000 Program Version(s): NOCRCMET_V6.27_02_09_16.CR1

10) Coded variable definitions

Sampling station:	Sampling site code:	Station code:
Research Creek	RC	nocrcmet

11) QAQC flag definitions

QAQC flags provide documentation of the data and are applied to individual data points by insertion into the parameter's associated flag column (header preceded by an F_). During primary automated QAQC (performed by the CDMO), -5, -4, and -2 flags are applied automatically to indicate data that is above or below sensor range, or missing. All remaining data are then flagged 0, as passing initial QAQC checks. During secondary and tertiary QAQC 1, -3, and 5 flags may be used to note data as suspect, rejected due to QAQC, or corrected.

-5 Outside High Sensor Range
-4 Outside Low Sensor Range
-3 Data Rejected due to QAQC
-2 Missing Data
-1 Optional SWMP supported parameter
0 Passed Initial QAQC Checks
1 Suspect Data
2 *Open - reserved for later flag*
3 *Open - reserved for later flag*
4 Historical Data: Pre-Auto QAQC
5 Corrected Data

12) QAQC code definitions

QAQC codes are used in conjunction with QAQC flags to provide further documentation of the data and are also applied by insertion into the associated flag column. There are three (3) different code categories, general, sensor, and comment. General errors document general problems with the CR1000, sensor errors are sensor specific, and comment codes are used to further document conditions or a problem with the data. Only one general or sensor error and one comment code can be applied to a particular data point, but some comment codes (marked with an * below) can be applied to the entire record in the F_Record column.

General Errors

GIM	Instrument Malfunction
GIT	Instrument Recording Error, Recovered Telemetry Data
GMC	No Instrument Deployed due to Maintenance/Calibration
GMT	Instrument Maintenance
GPD	Power Down
GPF	Power Failure / Low Battery
GPR	Program Reload
GQR	Data Rejected Due to QA/QC Checks
GSM	See Metadata

Sensor Errors

SDG	Suspect due to sensor diagnostics
SIC	Incorrect Calibration Constant, Multiplier or Offset
SIW	Incorrect Wiring
SMT	Sensor Maintenance
SNV	Negative Value
SOC	Out of Calibration
SQR	Data rejected due to QAQC checks
SSD	Sensor Drift
SSN	Not a Number / Unknown Value
SSM	Sensor Malfunction
SSR	Sensor Removed

Comments

CAF	Acceptable Calibration/Accuracy Error of Sensor
CCU	Cause Unknown
CDF	Data Appear to Fit Conditions
CML	Snow melt from previous snowfall event
CRE*	Significant Rain Event
CSM*	See Metadata
CVT*	Possible Vandalism/Tampering
CWE*	Significant weather event

13) Other remarks/notes

Data are missing due to equipment or associated specific sensors not being deployed, equipment failure, time of maintenance or calibration of equipment, or repair/replacement of a sampling station platform. Any NANs in the dataset stand for "not a number" and are the result of low power, disconnected wires, or out of range readings. If additional information on missing data is needed, contact the Research Coordinator at the reserve submitting the data.

Small negative PAR values are within range of the LI-COR sensor and are due to normal errors in the sensor and the CR1000 Datalogger. The Maximum signal noise error for the LI-COR sensor is +/- 2.214 mmoles/m2 over a 15 minute interval. These values are automatically flagged and coded as <1> (CAF).

Relative Humidity data greater than 100 are within range of the sensor accuracy of +/-3% and are flagged and coded as suspect, <1> (CAF). Values greater than 103 are rejected <-3>.

Data recorded for all parameters (with the exception of cumulative precipitation) at the midnight timestamp (00:00) are the 15 minute averages and totals for the 23:45-23:59 time period of the previous day. Cumulative precipitation data at the midnight timestamp (00:00) are the sum of raw (unrounded) precipitation data from 00:00 to 23:59 of the previous day. Summing each individual 15-minute total precipitation value from the same period will result in small differences from cumulative precipitation due to rounding. It is especially important to note how data at the midnight timestamp are recorded when using January 1st and December 31st data. **Note: Cumulative precipitation is no longer available via export from the CDMO. Please contact the Reserve or the CDMO for more information or to obtain these data.**

General

Data missed during station maintenance

Data not collected on 08/07/2017 11:15. RC Met station was not undergoing any maintenance. Cause of missing data unknown. Flagged <-2> [GPF] (CSM). All data are rejected at 11:30 since more than likely it is not a full 15 minutes of 5-second data.

15 min data for all parameters rejected due to station power down during maintenance

04/19/2017 14:30 Air temperature/RH, BP, and PAR sensors were swapped.
09/21/2017 11:15 MET station powered down so that repairs could be made to precipitation gauge.

2017 Solar Eclipse

08/21/2017 13:15 - 08/21/2017 15:00 -PAR data decreased during a partial solar eclipse (98% coverage) and returned to expected values. All data except total and cumulative precipitation are coded <0> [GSM] (CWE).

PAR

Nighttime PAR

Small negative PAR values and small elevated nighttime PAR values collected with the Apogee sensor are flagged and coded as <1>(CSM).

Wind

Anomalous Max wind data values of -447 or NAN were rejected as well as all associated discreet wind values.
06/13/2017 21:15
09/10/2017 02:00

Temp/RH

Relative Humidity values between 101 and 103 are within acceptable range of calibration and flagged <1> (CAF). Values >103 and/or NAN were rejected and flagged <-3> [SSM] (CSM). Following the sensor swap on 4/19/20017 there were instances when the RH sensor recorded higher than the range of the sensor accuracy. These data were either flagged as suspect or rejected, depending on the value. In addition, all other RH data that appear to be fine are flagged as suspect, <1>(CSM), and users should be aware that the sensor was having problems. The same pattern continued until the sensor could be replaced 11/20/2017 12:00.

Sensor replaced 11/20/2017 12:00 with upgraded Rotronic HC-2-S3. This caused a brief temp decrease by ~20C over the next two records followed by a return to expected values. RH errors appeared to cease following installation of a newly calibrated sensor. Affected temp and RH at 12:00 rejected (<-3> [SMT](CSM) and at 12:15 and 12:30 rejected (<-3> [SSM] (CSM)). Data overlapping the newly calibrated and old sensors seemed to match well.

12/17/2017 11:45 Avg/Min/Max Temp began to display sporadic negative jumps by 10-30 degrees. This was most evident in the MinTemp values(not available in the data but are available from the Reserve) which were used as a diagnostic in order to flag related ATemp/RH data. Adjacent data seem to fit conditions but negative temperature excursions are obviously a sensor error. Avg/Min/Max Temp values made a substantial departure from nearby reference weather stations

on the evening of 12/31/2017. Affected Temp/RH data at and following 12/17/2017 11:45 were flagged as rejected <-3> [SSM](CSM). Data that were not rejected are considered suspect, <1> (CSM).

Barometric Pressure

BP values recorded NAN for the following times following maintenance on 9/21/2017 at 11:15.
09/21/2017 11:15 rejected due to power down for maintenance
09/21/2017 11:30 -11:45 rejected due to NAN values recorded following power down

Precipitation

The precipitation sensor fell to the ground at some point between 07/05/2017 and 09/21/2017. The last visit to the MET station before the sensor fell was 07/05/2017 13:08 and the last precipitation data recorded was on 08/28/2017 03:15. All precipitation data, both total and cumulative, are coded as CSM from 07/05/2017 14:00 through 08/28/2017 03:15 since the exact date and time of the sensor falling are unknown, but this date is our best guess of last known precipitation data being recorded. Total and cumulative precipitation data are rejected 08/28/2017 03:30 through 09/21/2017 11:00 due to the malfunction, <-3>[SSM](CSM), and at 11:15 due to a station power down,
<-3>[GPD](CSM). Both total and cumulative precipitation data were rejected,
<-3>[SMT](CSM), on 09/21/2017 11:30 - 12:00 due to maintenance to repair and recalibrate the precipitation gauge. Cumulative precipitation data rejection continued through the end of the day, 09/22/2017 00:00. Total precipitation values recorded after the maintenance beginning at 9/21/2017 17:00 are accurate.